CEMENT JOINTS FOR CAST IRON WATER PIPE[1]

By George W. Pracy[2]

In April, 1917, the Spring Valley Water Company laid two sections of 4-inch cast iron pipe, using cement instead of lead in making the joints. This was in the nature of an experiment, none of the men ever having made a cement joint before. The line was thoroughly tested for leakage before being put into use and the results were so satisfactory that cement has been used in some 16,000 feet of 4-inch; 5000 feet of 6-inch and 16,000 feet of 8-inch cast iron pipe laid since that time. No larger size mains were laid during or since the war period; had any such been laid, cement would have been used. Over one mile of these lines has been in use more than two years under 175 pounds pressure without requiring any repairs. An 18-inch line is about to be laid in a neighboring town in which cement will be used for making the joints.

The use of cement is pretty general along the Pacific Coast. Clark Shaw of Long Beach describes the use of cement joints in Long Beach, California, in an article printed in the April, 1917 *Proceedings* of the American Society of Civil Engineers. F. M. Randlett of the Portland, Oregon, Water Works in the 1916 report of the Department of Public Utilities, recommends cement joints for all new work. P. D. Rice, formerly engineer for the San Jose Water Company and now connected with the Spring Valley Water Company, used cement to a considerable extent in San Jose. The East Bay Water Company of Oakland, California, the Los Angeles Water Department, as well as several smaller systems, also have used cement in some of their work.

Making the joint. In making the cement joint, the spigot end is put into the bell just the same as for a lead joint. Two rings of jute or yarn are then put around the pipe and driven into the bell in the regular manner. The jute used must be free from oil or tar. In some joints the jute was put in dry and in some it was soaked in

[1] Discussion of this paper is desired, and should be sent to the Editor.

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grout before being used. There was no apparent difference in the results.

When the jute is in place the cement is mixed. Neat cement of standard Portland Cement brand is used. The mix is very dry, the proportions being about 13 to 14 pounds of cement to 1 pound of water. This leaves the mixture so dry that it will crumble readily when handled. At no time should the mixture be wet enough to become sticky. The mixing is done in a pan or bucket, enough cement for one joint being mixed at a time. At first the men guessed at the amounts, taking what cement and water they thought was right. Later, measures were used, calibrated to give the amount of cement and water necessary, including waste, for a 4-, 6- and 8-inch joint.

When the cement is mixed ready for use, a canvas is placed under the joint to catch the waste. The operator takes a handful of cement and with an ordinary calking iron shoves the cement into the joint until the joint is full. He then takes a calking hammer and calks the joint until the cement is rammed in as hard as possible. The joint is then again filled and the operation repeated until the joint is completely filled with the rammed cement. At first a bead was put around outside the bell, but this was discontinued as being unnecessary. In handling the cement the men must wear gloves. After the joint is finished, it is covered with earth while the cement is hardening.

Amount of cement used. In putting the cement into the joints, considerable is lost, even though a canvas be placed to catch it. The amount used in making a joint depends entirely upon the carefulness of the operator. In some careful checks made it was found that from $5\frac{1}{2}$ to 10 pounds of cement were used in making an 8-inch joint. On an average, however, a 4-inch joint will take 5 pounds, a 6-inch 7 pounds, and an 8-inch 9 pounds. As cement out here costs less than one cent a pound, the cost for material is not very great and it does not pay to slow up the men by exacting the extreme of carefulness.

Cost of cement joints. Careful observation on the cost of lead joints made in laying over 45,000 feet of pipe in 1915 and of cement joints made in laying the 37,000 feet during the last three years, has resulted in the following comparative table of costs. The wage scales and material prices have been adjusted to meet present conditions.

	SIZE OF JOINTS		
	4-inch	6-inch	8-inch
Lead joints:			
Labor—Calker at $5.50; leadman at $4.75.....	$0.527	$0.723	$0.850
Lead—at 9½ cents per pound.....	.831	1.165	1.495
Coal—at $14 per ton.....	.015	.025	.026
Total.....	$1.373	$1.913	$2.371
Cement joints:			
Labor—$5.50 per 8-hour day.....	$0.30	$0.44	$0.58
Cement.....	.05	.07	.09
Total.....	$0.35	$0.51	$0.67
Saving per cement joint.....	$1.02	$1.50	$1.70
Saving per foot for 12-foot lengths.....	.08½	.12½	.14

The cost of yarn, amounting to a few cents a joint, has not been included as it is the same in both cases.

Leakage through joints when line is first filled. When water is first turned into the line with cement joints, every joint weeps badly and in some cases the water oozes out quite rapidly. In a few instances small pin-like streams have squirted out. In 24 hours this has practically all stopped and in two or three days the line is tighter than a line with lead joints.

On some jobs a meter was cut in on a by-pass around a closed gate so that the water to replace the leakage from the line was measured. The meter showed a leakage of 100 cubic feet or more the first day, dropping to a few cubic feet on the second day and practically nothing thereafter.

Leakage through cement joints. Four sections of pipe, about 1500 feet long, tested for leakage at the joints after the water had been in the pipe for a week, gave the following results: In the first section the leakage was ⅓ gallon per linear foot of pipe joint per 24 hours. The second section leaked so slowly that the leakage could not be measured. The last two sections were practically tight, the line being pumped to pressure and left standing in one case for ½ hour and in the other case 2½ hours without any drop in the pressure.

Flexibility of the cement joint. At San Jose a test section of 6-inch pipe was made, somewhat over 70 feet long, using cement joints.

This was first pumped to a pressure of 300 pounds without any leakage through the joints. The line was then put on supports so that it was elevated about 4 feet off the ground. With a normal working pressure of 60 pounds on the line, all but the two end supports were knocked out, permitting the pipe to be self-supporting over a span of 70 feet. The pipe dropped 2 feet in the center without causing any leakage at the joints. The line was then again lowered until it lay flat on the ground, while under normal working pressure; still no leakage. It was then emptied and left empty, exposed to temperature varying from 40° to 110°F. for nearly one year, after which it was again filled and the joints were all found to be tight.

Repairs to cement joints. In the first block of pipe laid, containing about 40 joints, 3 joints had to be cut out and remade. Since that time only 2 joints have continued to leak after the water was turned on. Both these joints were repaired by cutting out only that portion of the joint that was leaking and calking in lead wool. The pressure had to be taken off the line while the work was being done. Cutting out the joints on the 4-inch line took about 20 minutes. No joints in large pipe have been taken out.

One indirect advantage of cement joints is that they act as insulating joints and reduce the amount of current carried by the line. This feature is of particular importance in the larger cities where electrolytic action has done considerable damage. The cement joint increases the resistance of the pipe as a conductor to such an extent that the current carried is negligible.

Taking all things into consideration, it is believed that the cement joint has come to stay. Improvements over the present methods of making the joint will undoubtedly be made, but even at the present cost they are cheaper than any other joint known and from all the experience out here on the Pacific Coast they are entirely satisfactory.